10-1970

Andro Pool

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TWENTY-EIGHTH ANNUAL REPORT

PART THREE

ANDROSCOGGIN POOL

1970

Introduction. The Androscoggin Pool is that area of water situated between North Turner Bridge and Deer Rips Dam.

Daily tests were made at locations one, two, six and seven; stations three, four and five in the Pool were not sampled on Thursdays.

1. North Turner Bridge
2. Turner Center Bridge
3. Mile 4.25
4. Mile 2.5
5. Mile 1.0
6. Gulf Island Dam
7. Deer Rips Dam

Calculations are based on drainage area river flows at stations one and two, all other sampling locations on the average measured flow at Gulf Island Dam. Due to the very poor conditions in the Pool, a five week period, July twenty-seven to August twenty-nine, was chosen for intensive study. Benthal activity was large and extensive and equalled that of last year.

1. North Turner Bridge. The water entering the Pool always contains some suspended material and is quite large at times when the flow is much above normal. Due to higher than normal temperatures and lower river flows the daily soluble pollution load was about 18000 lbs. less than in 1969 but the available dissolved oxygen was over one hundred thousand pounds less

than last year. For the first time since 1965, the available oxygen was not sufficient to meet the incoming <u>five day</u> biochemical oxygen demands.

The record for this and the previous five years are tabulated below:

Summer Period	B.O.D.5 av.lbs/day	D.O. av.lbs/day	av. lbs/d Deficit- D.O. Surplus+
1970	73560	69940	- 3650
1969	91500	172240	+80740
1968	72200	141100	+68900
1967	68800	91700	+22900
1966	46800	55800	+ 9000
1965	36300	23300	-13000

The season net loss of measured B.O.D.5, during the estimated eleven day passage through the Pool, averaged 38900 lbs. per day, about 53% of the load entering the pool. The measured net loss of oxygen was 60800 lbs. per day which is 21900 lbs. more than the North Turner B.O.D.5, therefore, it may be assumed, that the daily benthal contribution was probably equal to 21900 lbs. plus all of the aeration in the Pool. The analytical results are summarized in the following tables.

North Turner Bridge

Period*	Dissolved Oxygen		B.O.D.5		Surplus D.O.+
	lbs/d	ppm	lbs/d	ppm	Deficit D.O.-
June 1-June 27	113590	6.3	93958	5.6	+19632
June 29-Aug. 1	63400	5.1	75768	5.9	-12368
Aug. 3-Aug. 29	39440	3.6	58720	5.4	-19280
Aug. 31-Sept. 12	60035	5.4	56959	6.1	+ 3076
Season average	69940	5.2	73560	5.8	- 3620

*Six days per week

DISSOLVED OXYGEN - BIOCHEMICAL OXYGEN DEMAND

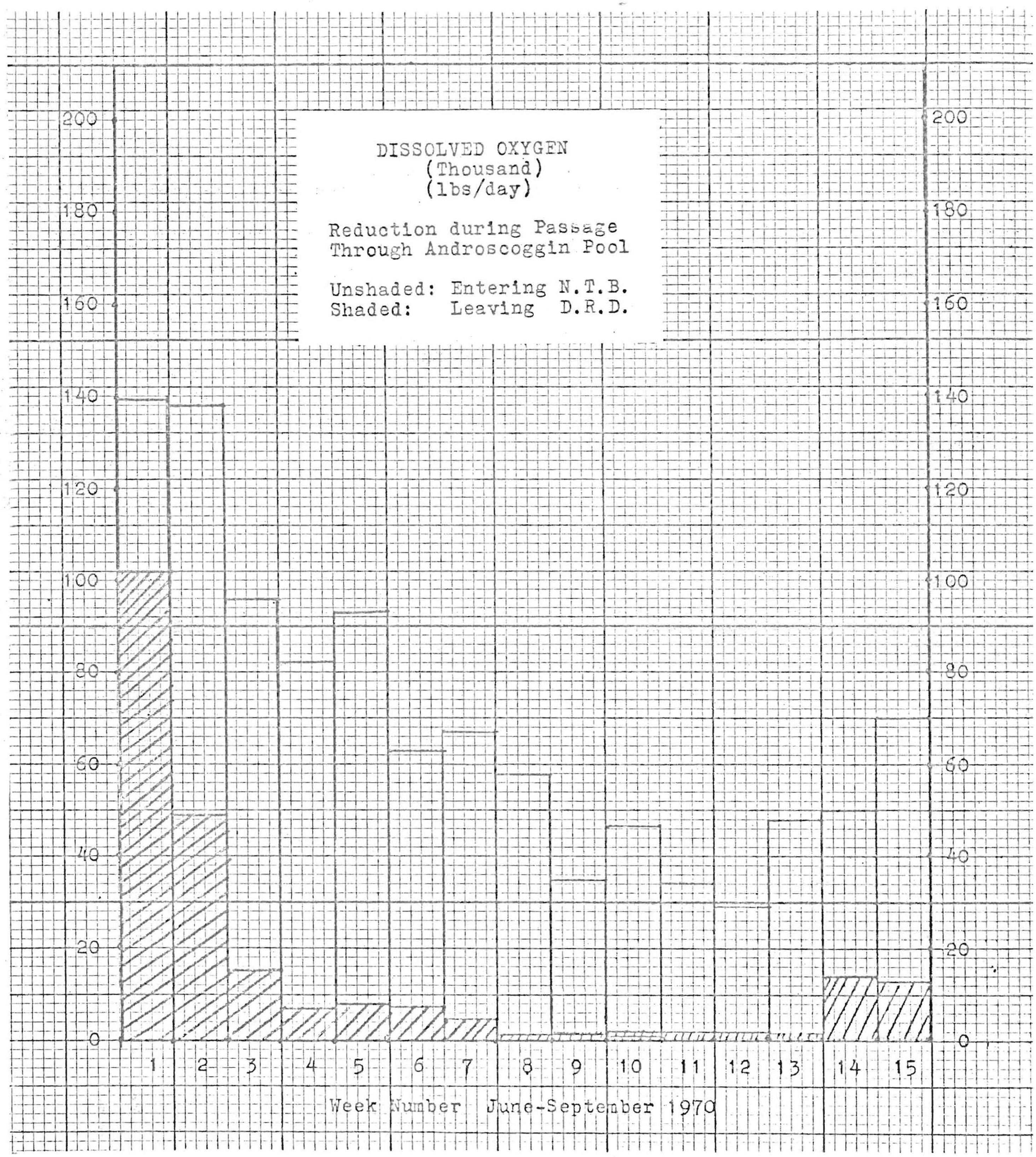
Weekly Average

1970

North Turner Bridge

Week* Ending	Dissolved Oxygen ppm	Dissolved Oxygen lbs/day	B.O.D.5 ppm	B.O.D.5 lbs/day	Surplus D.O.+ Deficit D.O.-
June 6	7.1	138823	5.0	97562	+41261
13	7.0	137753	4.9	95080	+42673
20	6.0	95638	5.9	93936	+ 1702
27	5.8	82150	6.4	89255	-25913
average	6.3	113591	5.6	93958	+19633
July 4	6.4	93525	6.9	99802	- 6277
11	6.3	63104	5.6	68017	- 4913
18	5.0	67364	6.2	83455	-16091
25	4.8	57881	5.6	68397	-10516
average	5.6	70469	6.1	79918	- 9449
Aug. 1	3.2	35129	5.4	59171	-24042
8	4.1	46490	4.8	54410	- 7920
15	3.2	34061	5.9	61386	-27325
22	2.9	29119	5.5	54314	-25195
29	4.2	48090	5.6	64602	-16512
average	3.5	38578	5.4	58777	-20199
Sept. 5	4.5	50108	7.3	80503	-30395
12	6.3	69960	4.9	33415	+36545
average	5.4	60035	6.1	56959	+ 3076
Season average	5.2	69940	5.8	73560	- 3620
Sept.19	5.7	62828	7.6	83732	-20904

*Six days per week


DISSOLVED OXYGEN
(Thousand)
(lbs/day)
Reduction during Passage
Through Androscoggin Pool
Unshaded: Entering N.T.B.
Shaded: Leaving D.R.D.
200
180
160
140
120
100
80
60
40
20
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Week Number June-September 1970

2. Turner Center Bridge. River flows at this station include the inflows from the Nezinscot River which were very low from June 29 to September 19. The approximate inflow is determined from the difference between the North Turner and Turner Center area drainage flows but does not allow for evaporation losses. The season's average inflow was 78 cfs and was "negative" for the month of August.

Nezinscot River

Period	Station N.T.B.	Station T.C.B.	Nezinscot Inflow to Pool
June 1-June 27	3182	3350	168 cfs
June 29-Aug. 1	2338	2426	88 "
Aug. 3-Aug. 29	2020	1995	- 25 "
Aug. 31-Sept. 19	2047	2073	26 "
Season average	2428	2506	≠ 78 "

Benthal deposits were very active during most of the summer in the area between the two Bridges. The extent of the activity may be seen in the following statistics for the period, July twenty-seven to August twenty-nine.

July 27 to August 29

Location	Dissolved Oxygen aver.lbs/d	Dissolved Oxygen ppm	B.O.D.5 aver.lbs/d	B.O.D.5 ppm
N.T.B.	38580	3.5	58780	5.4
T.C.B.	11040	1.0	42570	3.9
Change	-27540	2.5	-16210	1.5

The measured loss of dissolved oxygen averaged 27540 lbs/day accompanied by a known loss of B.O.D.5 of 16210 lbs/day. Time of passage was about two days and the distance between the Bridges 6.4 miles. August statistics tabulated on the next page are the basis for estimating the probable benthal B.O.D.5 diffused

Estimated Benthal Contribution

N.T.B.-T.C.B. Area

			July 27-Aug. 29	June 1-Sept. 19
1. B.O.D.5	Entering Pool (N.T.B.)	lbs/d	58800	73600
2. B.O.D.5	Estimated Loss to T.C.B. 50%	"	29400	36800
3. B.O.D.5	Measured Loss to T.C.B.	"	16200	12800
4. B.O.D.5	Estimate minus measured	"	13200	24000
5. B.O.D.5	Leaving T.C.B.	"	42600	60800

		July 27-Aug. 29	June 1-Sept. 19
1. D.O. entering Pool N.T.B.	lbs/d	38580	69900
2. Aeration N.T.B. rips Estm. 1.0 ppm	"	10800	13000
3. Aeration 1000 lbs/mile Estm.	"	7000	7000
4. Nezinscott av. cfs ppm	"	0	400
5. TOTAL	"	56400	90300
6. D.O. total - D.O. leaving T.C.B.	"	46400	43400
7. Indicated total D.O. loss	"	46400	43400
8. Measured B.O.D.5 loss	"	16200	12800
9. Probable Benthal B.O.D.5	"	30200	30600

Turner Center Bridge

Period	Dissolved Oxygen lbs/d	Dissolved Oxygen ppm	B.O.D.5 lbs/d	B.O.D.5 ppm	N.T.B. ⟶ T.C.B. D.O.lbs	N.T.B. ⟶ T.C.B. B.O.D.lbs
June 1-June 27	98429	4.9	80828	4.6	-15162	-13130
June 29-Aug. 1	38093	2.8	62880	4.7	-25307	-12888
Aug. 3-Aug. 29	10811	1.0	41580	3.8	-28629	-17140
Aug. 31-Sept.12	37910	3.4	54058	4.6	-22125	-2901
(Aug. 31-Sept.19	37379	3.3	61200	5.4)		
Season average	46880	2.9	60810	4.4	-23060	-12750

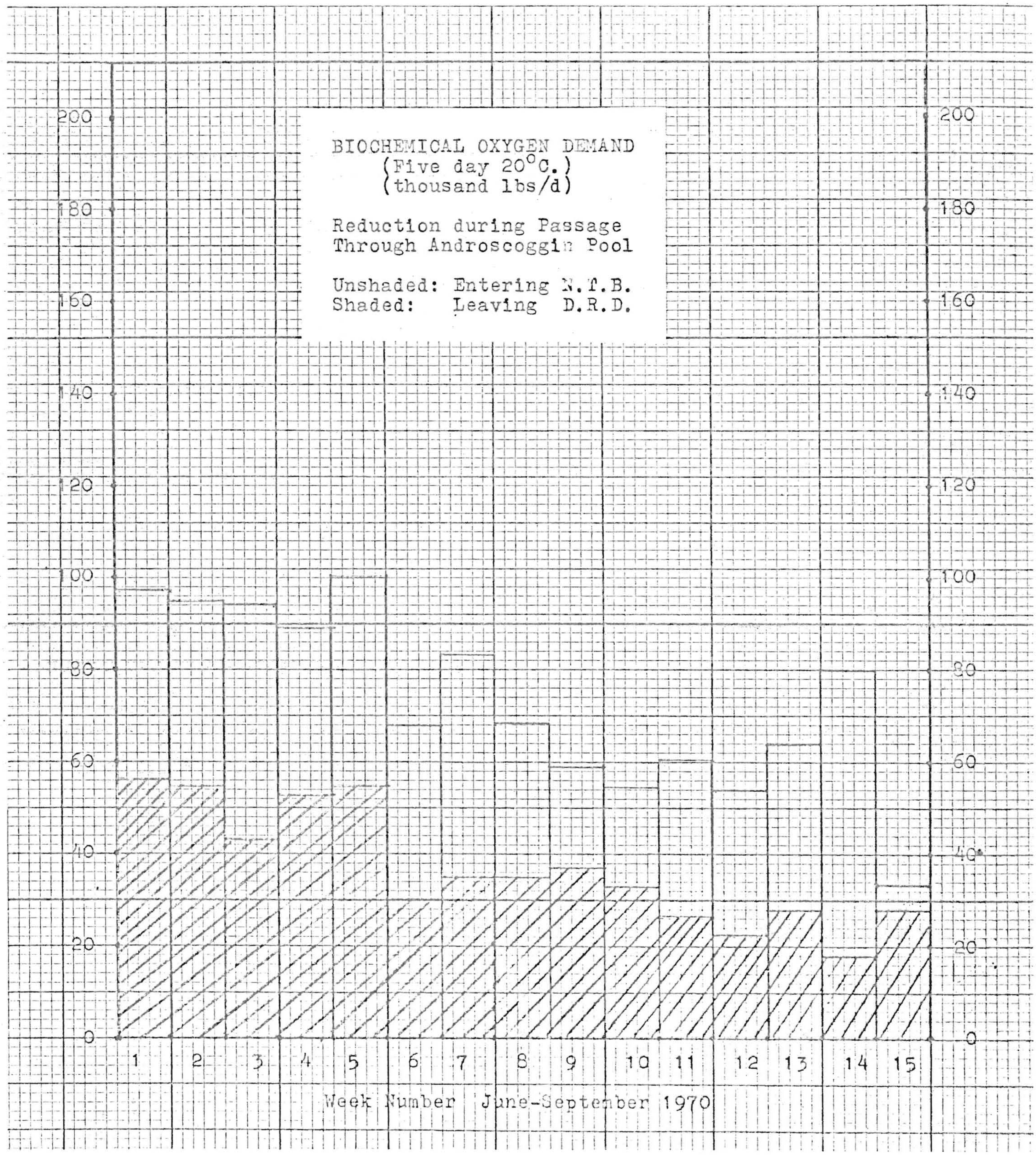
DISSOLVED OXYGEN - BIOCHEMICAL OXYGEN DEMAND

Weekly Average

1970

Turner Center Bridge

Week Ending	Dissolved Oxygen ppm	Dissolved Oxygen lbs/day	B.O.D.5 ppm	B.O.D.5 lbs/day	Surplus D.O.+ Deficit D.O.-
June 6	6.2	129060	4.3	89351	+39709
13	5.9	149793	4.0	80550	+69243
20	3.8	62740	4.9	80633	-17893
27	3.6	52120	5.1	72777	-20657
average	4.9	98429	4.6	80828	+17601
July 4	4.9	74396	5.0	77925	- 3529
11	3.2	38848	4.2	52235	-13387
18	2.7	36853	5.3	74756	-37913
25	2.3	28441	5.0	62952	-34511
average	3.3	44635	4.9	66967	-22332
Aug. 1	1.06	11926	4.2	46534	-34608
8	1.00	11438	3.5	41306	-29868
15	0.65	6863	4.1	42918	-36055
22	0.32	3050	3.9	37866	-34816
29	1.90	21894	3.9	44231	-22337
average	1.0	11036	3.9	42571	-31535
Sept. 5	2.9	32083	4.3	51805	-19722
12	3.9	43738	4.9	56312	-12574
average	3.4	37910	4.6	54058	-16148
Season average	2.9	46880	4.4	60810	-13927
Sept.19	3.2	36316	6.9	75485	-39169


BIOCHEMICAL OXYGEN DEMAND
(Five day 20°C.)
(thousand lbs/d)
Reduction during Passage
Through Androscoggin Pool
Unshaded: Entering N.T.B.
Shaded: Leaving D.R.D.
200
180
160
140
120
100
80
60
40
20
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Week Number June-September 1970

into the area, as about 30000 lbs. per day. Assuming the diffusion is uniform in the 760 acres, this is equivalent to 40 lbs. per acre. The close agreement between the calculated benthal diffusion loads for the five and fifteen week periods is probably a coincidence. For July 1969 the figures were 27700 lbs. per day and 36 lbs. per acre.

During August the highest recorded pollution load at North Turner was 6.8 ppm (70745 lbs B.O.D.5) and at Turner Center 4.8 ppm (50280 lbs). The lowest concentration of dissolved oxygen was 2.4 ppm, August 15 (N.T.B.) and 0.26 ppm August 22 (T.C.B.) respectively, seventeen days were recorded below one ppm.

3. Mile 4.25 This sampling station is located at the southern end of the narrows, about half way from each shore. The Pool area between Turner Center Bridge and Mile 4.25 has always had very active Benthal deposits. Along the eastern shore, from the north end of the narrows (Mile 4.75) to about Mile five, the benthal in a strip of about one hundred feet wide is extremely active, year after year. The net changes which occurred between these two stations are listed below:

T.C.B.-Mile 4.25 Area
July 27-August 29

Station	Dissolved Oxygen lbs/day	ppm	B.O.D.5 lbs/day	ppm	Temp.
T.C.B.	11040	1.0	42580	3.9	24.6
Mile 4.25	960	o.1	36220	3.3	24.8
Change	10080	0.9	6360	0.6	

DISSOLVED OXYGEN - BIOCHEMICAL OXYGEN DEMAND

Weekly Average

1970

Pool Mile 4.25

Week Ending	Dissolved Oxygen ppm	Dissolved Oxygen lbs/day	B.O.D.5 ppm	B.O.D.5 lbs/day	Surplus D.O. + Deficit D.O. -
June 13	4.2	89114	4.0	83379	+ 5735
20	2.4	39721	4.8	79819	-40098
27	1.3	17854	4.9	76686	-58832
average	2.6	48896	4.6	79961	-31065
July 4	3.1	47880	4.7	74040	-26160
11	1.3	16882	3.7	46722	-29840
18	0.56	7698	4.4	62277	-54579
25	0.50	6381	4.4	55507	-49126
average	1.4	19710	4.3	59637	-39927
Aug. 1	0.07	829	4.0	44474	-43645
8	0.05	578	2.8	33945	-33367
15	0.09	1000	3.0	31123	-30123
22	0.0	0	3.8	36383	-36383
29	0.2	2393	3.0	35190	-32797
average	0.08	960	3.3	36223	-35263
Sept. 5	1.3	14543	3.6	40420	-25877
12	1.6	17746	4.3	48632	-30886
19	2.3	25597	4.5	50890	-25293
average	1.7	19295	4.1	46647	-27352
Season average	1.3	18127	4.0	53015	-34888

Abnormal high temperatures were present in the Pool, expecially from July 28 to August 17. In this area between these dates, the lowest recorded temperature was 24.8 and the highest 27.5 centigrade.

Only a very small amount of dissolved oxygen entered the area -about 11000 lbs. per day- and almost none passed out downstream. A measured decrease of about 6400 lbs. B.O.D.5 was recorded, hence the minimum benthal contribution would be, 11000 minus 6400 plus the unknown aeration in the area.

Mile 4.25

Period	Dissolved Oxygen lbs/d	ppm	B.O.D.5 lbs/d	ppm	T.C.B. —— 4.25 D.O.lbs	B.O.D.lbs
June 8-June 27	48896	2.58	79961	4.6	-39322	- 1974
June 29-Aug. 1	15934	1.11	56604	4.3	-22159	- 6276
Aug. 3-Aug. 29	990	0.04	34160	3.2	- 9820	- 7440
Aug.31-Sept.19	19295	1.7	46647	4.1	-18084	-14553
Season average	18130	1.3	53020	4.0	-22570	- 6870

Dissolved oxygen available in this area was almost entirely consumed by the pollution load; the measured oxygen exceeded the five day B.O.D. loss by 3700 lbs/day. The season's average daily loss of oxygen was 22600 lbs and the reduction of the B.O.D.5 load was only 6900 lbs. per day, indicating a probable minimum benthal contribution of 15700 lbs. B.O.D.5

Station	Period	Dissolved Oxygen lbs/d	ppm	B.O.D.5 lbs/d	ppm
Turner Center Bridge	June 8-Sept.19	40700	2.7	59900	4.6
Mile 4.25	June 8-Sept.19	18100	1.3	53000	4.0
Decrease		22600	1.4	6900	0.6

3. Mile 2.5 This station is located about two and one-half miles north of Gulf Island Dam and in a relatively narrow section, in the southern end of the Pool. This stretch of the Pool covers a much larger area than the two located north of it.

Mile 4.25-Mile 2.5 Area

July 27-August 29

Station	Dissolved Oxygen ppm	Dissolved Oxygen lbs/day	B.O.D.5 ppm	B.O.D.5 lbs/day
Mile 4.25	0.1	960	3.3	36220
Mile 2.5	0.0	(97)	3.6	39570
Change	-0.1	900	+0.3	3350

This area of the Pool was, for all practical purposes, anaerobic from July 11 to September 2. About 960 lbs/day of oxygen entered and 'none' left the area. Under such conditions it is not surprising that the average B.O.D.5 load increased; the magnitude of the measured increase, 3350 lbs, per day, was unexpectedly small. The statistics for the fifteen week period, indicate a daily average net loss of 9300 lbs. of oxygen and also 7600 lbs. of B.O.D.5

Station	Period	Dissolved Oxygen ppm	Dissolved Oxygen lbs/d	B.O.D.5 ppm	B.O.D.5 lbs/d
Mile 4.25	June 8-Sept. 19	1.3	18100	4.0	53000
Mile 2.5	June 8-Sept. 19	0.6	8800	3.5	45400
Decrease		0.7	9300	0.5	7600

On many days large areas were covered with floating sludge and pig-pen was almost a persistent odor. Hydrogen sulfide in varying intensities was present in the air usually in the southern half from mid-July until late August. "Gassing" was continuous

DISSOLVED OXYGEN - BIOCHEMICAL OXYGEN DEMAND

Weekly Average

1970

Pool Mile 2.5

Week Ending	Dissolved Oxygen ppm	Dissolved Oxygen lbs/day	B.O.D.5 ppm	B.O.D.5 lbs/day	Surplus D.O.+ Deficit D.O.-
June 13	3.5	73300	3.4	71482	+ 1818
20	1.6	27227	3.7	61135	-33908
27	0.82	1230	5.0	73396	-72166
average	2.0	33919	4.0	68671	-34752
July 4	0.60	8847	3.6	56033	-47186
11	0.52	6771	3.6	44955	-38184
18	0.05	677	3.2	44341	-43664
25	0.08	921	3.6	45201	-44280
average	0.31	4304	3.5	47633	-43329
Aug. 1	0.00	0	3.9	44033	-44033
8	0.00	0	3.8	44598	-44598
15	0.00	0	3.3	34594	-34594
22	0.00	0	3.9	38080	-38080
29	0.04	487	3.2	36552	-36065
average	0.01	97	3.6	39571	-39474
Sept. 5	0.15	1746	2.4	27030	-25284
12	0.10	1167	2.8	31921	-30754
19	0.95	10361	2.4	27208	-16847
average	0.40	4424	2.5	28720	-24296
Season average	0.56	8849	3.5	45370	-36522

and extensive. Occasionally large oil slicks were observed.

Mile 2.5

Period	Dissolved Oxygen lbs/d	Dissolved Oxygen ppm	B.O.D.5 lbs/d	B.O.D.5 ppm	Mile 4.25 → Mile 2.5 D.O. lb/d	Mile 4.25 → Mile 2.5 B.O.D. lb/d
June 8-June 27	33919	2.0	68671	4.0	-14977	-11290
June 29-Aug. 1	3443	0.25	46913	3.6	-12491	- 9691
Aug. 3-Aug. 29	122	0.01	38456	3.6	- 868	+ 4296
Aug. 31-Sept. 19	4424	0.40	28720	2.5	-14871	-17927
Season average	8850	0.56	45370	3.5		

<u>5. Mile One</u>. Mile One sampling station is located in the Mile 2.5 - Deer Rips Dam area. Water was sampled for Methylene stability and for dissolved oxygen. cf Methylene Blue later in this report.

<u>6. Gulf Island Dam</u>. Water samples obtained at the ten foot depth are not representative. Tests for dissolved oxygen were made six days a week and biochemical oxygen demands on Thursdays and Saturdays. Mechanical aeration, described later in this report, maintained an aerobic condition in the upper fifteen foot layer of water entering the turbines.

<u>7. Deer Rips Dam</u>. The statistics recorded here include the effects of mechanical and natural aeration. The thorough mixing which occurs at Gulf Island power plant makes the samples taken in the canal at Deer Rips representative of the river water passing downstream at that time.

Results of the tests are summarized in the tables:

Mile 2.5 - D.R.D. Area

July 27-August 29

Station	Dissolved Oxygen lbs/d	Dissolved Oxygen ppm	B.O.D.5 lbs/d	B.O.D.5 ppm
Mile 2.5	0.0	0.0	39570	3.6
Deer Rips Dam	1610	0.2	24490	2.7
Change	+1610	0.2	-15080	0.9

Station	Period	Dissolved Oxygen lbs/d	Dissolved Oxygen ppm	B.O.D.5 lbs/d	B.O.D.5 ppm
Mile 2.5	June 8-Sept.19	8800	0.6	45400	3.5
Deer Rips Dam	June 8-Sept.19	9100	0.6	34700	2.7
Change		+ 300	0	-10700	0.8

The measured increase of dissolved oxygen in this area is very small but is believed to be real. The reduction in measured B.O.D.5 is very significant as it indicates that an equivalent oxygen 'pick-up' must have occurred during passage through area. Much of the benthal in the southern half of this sector is old, humic and relatively inactive. Gas bubbles are observed but small in number compared to those seen upstream.

Deer Rips Dam

Period	Dissolved Oxygen lbs/d	Dissolved Oxygen ppm	B.O.D.5 lbs/d	B.O.D.5 ppm	Mile 2.5 → D.R.D. D.O.lb/d	Mile 2.5 → D.R.D. B.O.D.lb/d
June 8-June 27	43297	2.2	51672	2.9	-10373	-16999
June 29-Aug.1	4765	0.33	38351	2.9	+ 1322	- 8562
Aug. 3-Aug.29	1610	0.18	29489	2.7	+ 1513	-10082
Aug.31-Sept.19	11750	1.1	22315	2.0	+ 7326	+ 6365
Season average	9130	0.6	34650	2.7		

DISSOLVED OXYGEN - BIOCHEMICAL OXYGEN DEMAND

Weekly Average

1970

Deer Rips Dam

Week Ending	Dissolved Oxygen ppm	Dissolved Oxygen lbs/day	B.O.D.5 ppm	B.O.D.5 lbs/day	Surplus D.O.+ Deficit D.O.-
June 6	5.0	102550	2.7	56254	+46296
13	2.4	49076	2.6	54462	- 5386
20	0.87	14586	2.6	43384	-28798
27	0.46	6976	3.7	52590	-45614
average	2.2	43297	2.9	51672	- 8375
July 4	0.54	8332	3.6	54771	-46439
11	0.59	7493	2.5	30191	-22698
18	0.37	5345	2.5	34867	-29522
25	0.14	1770	2.8	34886	-33116
average	0.41	5735	2.9	38678	-32943
Aug. 1	0.10	891	3.3	37040	-36149
8	0.19	2082	2.9	33179	-31097
15	0.18	1922	2.5	26580	-24658
22	0.19	1806	2.4	22409	-20603
29	0.20	1348	2.5	28239	-26890
average	0.18	1610	2.7	29489	-27879
Sept. 5	1.3	14028	1.6	17967	- 3939
12	1.1	12452	2.5	28020	-15568
19	0.8	8770	1.9	21088	-12318
average	1.1	11750	2.0	22355	-10605
June 8-Sept.19 Season average	0.63	9130	2.7	34650	-25520
June 1-Sept.19 Season average	0.90	14970	2.7	36000	-21030

ANDROSCOGGIN POOL

~~June~~ July 27 to August 29

1970

Station	B.O.D.5 lbs/day	B.O.D.5 change	D.O. lbs/day	D.O. change
N.T.B. (into Pool)	58800		38600	
N.T.B. to T.C.B.	42600	-16200	11000	-27600
T.C.B. to Mile 4.25	36200	- 6400	1000	-10000
Mile 4.25 to Mile 2.5	39600	+ 3400	0	- 1000
Mile 2.5 to D.R.D.	24500	-15100	1600	+ 1600
N.T.B. into Pool	58800		38600	
D.R.D. out of Pool	24500		1600	
Loss Measured	34300		37000	
Loss percent	58.3		95.9	
		K_1 0.08	k_1 0.18	

These statistics are based on the measured dissolved oxygen and five day biochemical oxygen demands at each station, the losses and gains indicate the NET change. All aeration gains are consumed in the microbial action on the benthal products, and "residual" B.O.D. from upstream.

AERATION in the ANDROSCOGGIN POOL

<u>Natural Aeration</u>
a. North Turner

River water passing over the rips, just south of North Turner Bridge, is aerated to the extent of 0.75 to 1.25 ppm, depending on flow, temperature etc. For purposes of calculating the probable diffusion effects from the benthal in the sector between the two bridges, an assumption is made that the aeration would average one part per million.

<u>b. Nezinscot River.</u> The inflow from the Nezinscot River to the Pool was much below normal; during

August it was neglible. The season average was about eighty cubic feet per second, with a D.O. about five ppm and B.O.D.5 varying from one to two ppm.

Surface
c. Aeration in the Pool. From Turner Center to Deer Rips Dam, surface aeration varies from hour to hour, due to variations of wind direction and velocity, surface film, benthal floaters etc. Aeration in the Pool, south of Turner Center Bridge, is doubtless considerable but it remains unknown.

Mechanical Aeration.
Gulf Island Dam. The pulp and paper companies three aerators were placed in position the first week of June and continuous operation was begun on June 18. The operation log is listed below.

The aerators have proved their worth again this year. Only five zero days were recorded at Deer Rips Dam, one in June, two in July and three in August. Although the water arriving in the area of the aerators was practically devoid of oxygen, there were no test days when the dissolved oxygen was recorded as zero in the upper fifteen feet and during July and August most of the analyses were in the region of one part per million. Hydrogen sulfide was present in lowest layers, so the added oxygen probably reacted with it when mixing occurred in the turbines.

Aerator Log

1.	June 9	Start up 1:00 pm and shut down June 10, 1:15 pm
2.	June 18	Start up 5:00 pm for continuous operation.
3.	June 27	Central Maine Power Company shut aerators down 1:50 pm to 3:15 pm.
4.	July 1	Stewart and Williams shut down 8:00 am to 3:00 pm to grease and replace center cable.
5.	July 4	Severe electrical storm. Circuit breakers shut aerators down 7:59 pm. Dispacher requested permission to start them up and did so 8:41 pm.
6.	July 22	Stewart and Williams shut aerators down about three hours to grease the motors.
7.	July 25	Stewart and Williams shut down aerators for four hours to change the oil.
8.	July 28	We shut aerators down for four hours to remove a huge tree and branches caught in the power cables lines.
9.	September 13	Stewart and Williams shut aerators down, 7:00 am to 8:45 pm to permit divers to remove grates at inlet number two.
10.	September 16	Shut down at 8:45 am and notified Mr. Wright (S. & W. Co.) that they could be removed from the water anytime after October one.

<u>METHYLENE BLUE STABILITY.</u> On July eighteen a decision was made to make methylene blue stability tests on river water, sampled at Mile 4.25, Mile 2.5 and Mile one. The results obtained were valuable, because of the early indications they gave of serious conditions developing in the Pool and also of the increasing stability, even though the dissolved oxygen tests were yielding zero or very low concentrations.

Stability tests gave the first indications that pollution conditions had passed over the "hump". The accompaning tables contain the results of these tests and the dissolved oxygen in samples taken simultaneously.

<u>PHOSPHATE.</u> The concentration of phosphate in river and lake waters may be related to the growth of algae. Some biochemists state that phosphates directly stimulate the growth of algae, while others believe that phosphates play a minor role and that organic matter and certain microbial by-products are nutrients for algae. The September issue of Environmental Science and Technology contains a review of the two schools of thought. Xerox copies are inserted in this report.

Blue-green algae occasionally appear in very small amounts in the Androscoggin Pool, usually on small pieces of floating sludge. This year a few patches were observed floating on a thin film of "slime".

On August 26 river water samples were taken at five locations in the Pool and one at North Turner Bridge. Analyses were made by the 'Standard Methods' procedure and the results are recorded below. Spectronic 20 was used for the optical determinations.

	Location	Phosphate ($\equiv PO_4$) ppm	Date
1.	North Turner Bridge	0.07	August 26
2.	Turner Center Bridge	0.10	" 26
3.	Mile 4.25	0.07	" "
4.	Mile 2.5	0.05	" "
5.	Gulf Island Dam	0.10	" "
6.	Deer Rips Dam	0.05	" "

The water tested entered the Pool on six different days and the longest time of passage through the Pool was about eleven days.

These results appear to indicate that the phosphate concentration may not be sufficient to stimulate excessive growth of algae. On August 28 at Mile 2.75, two small patches of blue green algae were observed, a 400 ml sample from one of them was taken together with the slime and grass filaments. After standing for about five hours the slime appeared to disintegrate. The sample was carefully filtered and the filtrate, when tested contained 0.06 ppm phosphate ($\equiv PO_4$), essentially the same as in the Pool water.

Tests made at Gilead by the Federal Water Pollution Control Administration in 1969 indicate "phosph" concentrations of 0.03 to 0.05 ppm. The Federal 'Gold Book', 1954, and the State of Maine 'Androscoggin River Classification', 1966, do not contain any data on phosphorus in the river water.

<u>Odor</u> of Part four of this report.

The great phosphorus controversy

Arguments over the controlling mechanisms of eutrophication have scientists—and politicians—all hot under the collar

A furious controversy over the role played by phosphorus in the excessive growth of algae in lakes and streams is currently raging within a section of the technical community. Although the arguments bandied back and forth are scientific in nature, their implications go far beyond the laboratory. The issue involved is whether phosphorus is indeed the key element controlling algal growth; the assumption that it is underlies all current efforts to remove phosphorus from sewage and to replace the condensed phosphates in household detergents with a nonphosphate substitute (see ES&T, February 1970, page 101, and July 1970, page 544).

Dieoff. *Decaying algae disfigure Montrose Beach on Lake Michigan shorefront*

An accepted fact

For many years, the key importance of phosphorus (and of nitrogen) to the growth of aquatic algae was taken as absolute fact—and indeed the majority of water chemists and limnologists (scientists who study freshwaters) never did doubt that fact and do not do so now. Studies of the eutrophication (advanced biological aging) of bodies of water have for many years focused on the increased amounts of phosphorus and nitrogen entering the water, which, in practically all cases, accompanied excessive algal growth. The connection has been accepted as so obvious and proven that no argument was really expected.

First hints of the furor yet to come appeared in 1967, when Willy Lange, a chemist turned botanist at the University of Cincinnati, published in *Nature* a paper entitled "Effect of Carbohydrates on the Symbiotic Growth of Planktonic Blue-Green Algae with Bacteria." Lange's thesis was that algae always exist in association with bacteria and that the association is mutually supportive: the algae utilize carbon dioxide and sunlight to produce organic matter and oxygen by photosynthesis; the bacteria use oxygen in the decomposition of organic matter to produce carbon dioxide. Lange's experiments proved to his satisfaction that it was the presence of large amounts of organic material in water that made the production of huge amounts of carbon dioxide available for algal growth.

Lange's contentions were picked up and given added currency in 1969, when L. E. Kuentzel, a Wyandotte Chemical Corp. physical chemist, reviewed the literature on eutrophication and concluded (without ever having performed an experiment himself, as his critics are quick to point out) that carbon, not phosphorus, is the element that controls algal growth.

Kuentzel followed Lange's reasoning that only bacterial action on dissolved organic matter could possibly produce the amounts of carbon dioxide needed for the algae to grow rapidly. According to Kuentzel, all the literature citations he studied pointed to the fact that there was sufficient organic matter present, together with phosphorus and nitrogen, to support his thesis concerning carbon dioxide production and utilization by algae. Furthermore, continued Kuentzel, in many reported cases of excessive growth, dissolved phosphorus levels were exceedingly small. So small, in fact, that they were in some cases less than the 0.01 p.p.m. previously suggested as the minimum phosphorus concentration needed for abundant growth, a criterion provided by University of Wisconsin sanitary chemist Clair Sawyer in the 1940's. Kuentzel's interpretations were roundly opposed by members of what has been called, with considerable risk of oversimplification, the phosphorus-is-the-key school of thought.

Then, at the 1970 Purdue Industrial Waste Conference, Pat Kerr, a plant physiologist at the Federal Water Quality Administration (FWQA) Southeast Water Laboratory (Athens, Ga.), presented the results of work done by her and two colleagues from which she concluded that carbon was the controlling element. Miss Kerr's results were an extreme embarrassment to FWQA and to the federal government, who were gearing up (albeit somewhat tentatively) for a switch away from phosphates in detergents and were spending heavily on the development of processes for the removal of phosphorus from liquid

Two schools of thought clash on many points

Carbon-is-key school believes:	Phosphorus-is-key school believes:
Carbon controls algal growth.	Phosphorus controls algal growth.
Phosphorus is recycled again and again during and after each bloom.	Recycling is inefficient: some of the phosphorus is lost in bottom sediment.
Phosphorus in sediment is a vast reservoir always available to stimulate growth.	Sediments are sinks for phosphorus, not sources.
Massive blooms can occur even when dissolved phosphorus concentration is low.	Phosphorus concentrations are low during massive blooms because phosphorus is in algal cells, not water.
When large supplies of CO_2 and bicarbonate are present, very small amounts of phosphorus cause growth.	No matter how much CO_2 is present, a certain minimum amount of phosphorus is needed for growth.
CO_2 supplied by the bacterial decomposition of organic matter is the key source of carbon for algal growth.	CO_2 produced by bacteria may be used in algal growth, but main supply is from dissociation of bicarbonates.
By and large, severe reduction in phosphorus discharges will not result in reduced algal growth.	Reduction in phosphorus discharges will materially curtail algal growth.

wastes. Swept along by wide interest in Miss Kerr's work and by a long, gutsy, and polemical attack on the whole phosphorus school in *Canadian Research and Development* magazine, battle lines were drawn. Lange, Kuentzel, and Miss Kerr were, once again for the convenience of argument, lumped together as the carbon-is-key school, and their arguments were heatedly discussed by high level groups in FWQA and the Council on Environmental Quality (CEQ).

Counterattack

However, the phosphorus school counterattacked strongly and its arguments seem, at the moment, to have carried the day. Both the phosphorus and carbon schools agree that algae need, for growth, sources of inorganic carbon, phosphorus, nitrogen, and numerous other elements such as metals. Both schools further agree that algae and bacteria generally coexist, and the phosphorus school is willing to concede that the relationship may be symbiotic. But on almost all other points, they disagree (see table). At the very nub of the disagreement are two basic areas of contention:

- Precisely how much phosphorus do algae need for excessive growth.
- What sources of carbon are available to algae.

The carbon school maintains that only very small amounts of phosphorus are needed. It points to the low dissolved phosphorus concentrations found in the water of eutrophic lakes during algal blooms and believes that nutrients, including phosphorus, are recycled by organisms during growth and released for reuse during the periodic dieoff periods. Says the phosphorus school: On the contrary, algae require relatively substantial amounts of phosphorus and the incidence of low dissolved phosphorus concentrations during a bloom means that the phosphorus has been taken up by the algal cells.

The carbon school believes that the availability of utilizable carbon is the key and that diffusional processes are too slow to permit atmospheric CO_2 to support massive growth, hence its interpretation of the importance of bacteria-produced CO_2. The phosphorus school points to the fact that algae can use, in addition to free CO_2, carbon dioxide produced by the dissociation of dissolved bicarbonates. Phosphorus supporters say that the dissociation occurs so rapidly that supply of carbon dioxide cannot possibly be limiting, and they pooh-pooh the carbon school emphasis on the need for respiratory supply.

It is very easy to convey the wrong impression that all scientists fall simply into one or other of the two camps. In fact, most probably see some merit in both sets of arguments. Phosphorus supporters, including University of Minnesota limnologist Joseph Shapiro, have told ES&T that they believe with Pat Kerr that carbon was indeed the controlling element in her studies. The reason for this, they say, is that Miss Kerr worked with the waters of several southern lakes in which dissolved bicarbonates are very low, and in a situation where nitrogen and phosphorus were very high. Miss Kerr herself is willing to concede that her results may not hold true "for all waters in all places at all times." She does feel, however, that removal of phosphorus but not of organic carbon from liquid wastes probably spells trouble. Phosphorus supporters continue to point out that most lakes, streams, and estuaries contain abundant supplies of inorganic carbon, and they stick with their belief that, in general, phosphorus is controlling. They do not believe that removal of phosphorus from wastes will halt all algal growth; they do believe, however, that growths will be much diminished.

Governmental bodies obviously are going along with the phosphorus school. In Canada, the federal government gave detergent manufacturers until August 1 to reduce the phosphate content of detergents to 20% (expressed as P_2O_5—roughly equivalent to 35% expressed as sodium tripolyphosphate), and is aiming toward a total ban by the beginning of 1972. The U.S. government has not gone as far, however. Rep. Henry Reuss's (D.-Wis.) bill to limit phosphorus in detergents is languishing in a Congressional committee, but FWQA scientists are working on a crash program to evaluate the ecological effects of sodium nitrilotriacetate (NTA), the most likely present substitute for phosphate in detergents. And spokesmen for both FWQA and CEQ say that they are entirely convinced of the merits of the case against phosphorus.

Whether the current furor will testify to the supremacy of science over politics, only time will tell. But one thing is sure—man has been responsible for the advanced eutrophication of lakes through something he has added to them in the course of his technological and social progress. It is not unreasonable to hope that all the work that has been lavished on the role of phosphorus in eutrophication will eventually result in ways to remove that something, whatever it eventually turns out to be. DHMB

<u>Labor Day Holiday Period</u> The shut-downs for Labor day holiday period made possible a study of an approximate Time of Passage and determination of the variations in the Pollution Loads at the important sampling stations. The shut-down periods were:

a. Brown Company. None. Continuous operation.

b. Oxford Paper Company. Shut-down eleven pm Friday September four. Discharge to river, normal to size pm, then erratic to three am Saturday. Start-up September eight. Large discharge to river ten am to twelve noon. Erratic until five pm. Normal to seven am (9th) then large to two pm. September ten twice normal load to the river.

c. International Paper Company. Shut-down seven am. September seven. Clarifier clean up completed before shut-down. Very little pollution discharged after seven am (7th). Start-up eleven pm Thursday September ten. Digester operated 'batch' until 'continuous'. First pollution to the river about seven to eight am Friday (11th)

The comments and conclusions presented are based on the following Log.

Androscoggin River Data
Labor Day Holiday
1970

RIVER

	Station	Date Sept.	B.O.D.5 ppm	D.O. ppm
1.	Virginia Bridge	4	2.3	5.4
		7	2.0	5.5
2.	Dixfield Bridge	4	7.7	5.6
		5-6	-	-
		7	2.1	6.4
		8	3.1	6.6
		9	11.2	6.0
3.	Canton Point	4	5.0	5.3
		5-6	-	-
		7	2.4	6.3
		8	2.7	6.7
		9	5.1	5.8
4.	Riley Dam	8	6.4	5.1
		9	6.7	5.5
		10	4.7	5.5
		11	9.0	5.4
		14	11.8	4.7
5.	Otis Chisholm	8	7.0	7.6
		9	6.8	7.6
		10	3.3	7.8
		11	8.1	7.5
6.	Livermore Falls	8	6.6	7.8
		9	6.2	8.2
		10	3.6	7.8
		11	6.2	8.0

POOL

	Station	Date Sept.	Time	B.O.D.5 ppm	D.O. ppm
7.	North Turner Bridge	8	9 am	8.2	5.2
			7 pm	7.1	5.0
		9	9 am	3.3	6.6
			5 pm	2.1	7.3
		10	7 am	3.4	7.0
			5 pm	2.4	7.1
		11	9 am	2.9	7.1
			7 pm	2.6	6.9
		12	9 am	4.4	6.6
			7 pm	9.6	5.6
8.	Turner Center Bridge	9	9 am	5.0	3.1
		10	7 am	5.1	2.9
		11	9 am	1.9	5.6
			7 pm	Lost	-
		12	8 am	2.2	5.8
			6 pm	2.1	6.0
		14	9 am	5.2	3.9
9.	Mile 4.25	9	11 am	5.6	1.2
		11	10 am	3.7	2.0
		12	11 am	2.2	3.1
		14	11 am	2.3	4.4
		15	11 am	3.8	2.7
		16	11 am	7.1+	0
10.	Mile 2.5	11	10 am	3.3	0.1
		12	10 am	2.9	0.1
		13	10 am	1.7	0.8
		14	10 am	1.6	2.0
		15	10 am	1.7	1.8
		16	10 am	-	0.1
		18	10 am	3.6	0.1
11.	Deer Rips Dam	12	8 am	2.9	0.3
		14	8 am	2.4	0.8
		15	8 am	1.9	0.9
		16	8 am	1.4	0.9
		17	8 am	2.0	0.8
		18	8 am	1.6	0.8*
		19	8 am	2.0	0.5
		21	8 am	3.8	0.06

*Probably the real low

Unfortunately there were no tests made September five and six in the Rumford area. The 'Zero days' at Virginia are September 5-6-7 and it is assumed that the average dissolved oxygen was 5.5 ppm and the B.O.D.5 2.2 ppm during these three days. The measured B.O.D.5 'lows' and the dissolved oxygen 'highs' are tabulated below.

Station	D.O.low Period Sept.	D.O. High ppm	B.O.D.5 low Period Sept.	B.O.D. low ppm
1. Virginia Bridge*	5-6-7	5.5*	5-6-7	2.2*
2. Dixfield Bridge	5-6-7	6.6(8)	5-6-7	2.1(7)
3. Canton Point	6-7-8	6.7(8)	6-7-8	2.4(7)
4. Riley	9-10-11**	5.5	9-10-11	4.7
5. Chisholm, Otis	9-10-11**	7.8	9-10-11	3.3
6. Livermore Falls	9-10-11**	7.8	9-10-11	3.6
7. North Turner Bridge	9-10-11	7.1	9-10-11	2.1
8. Turner Center Bridge	11-12-13	6.0(12)	11-12-13	1.9
9. Mile 4.25	12-13-14	4.4(14)	12-13-14	2.2 2.3
10. Mile 2.5	13-14-15	2.0(14)	13-14-15	2.0
11. Deer Rips Dam	15-16-17-18	0.9(16)	15-16-17-18	1.4

*Not a high or low; 'normal'.
**cf Previous Table

These data indicate a Time of Passage about the same as we have been using for the river, slightly less for the Pool. Brown Company pollution load at Virginia Bridge 2.2 ppm arrived at North Turner as 2.1 ppm indicating no net change from Dixfield. Interpretation of the data from the Riley-Livermore Falls area is difficult. A large increment in pollution load may have occurred between Canton Point and Riley and was oxidized before arriving at North Turner.

The measured low at Turner Center was 1.9 ppm, at Mile 4.25, 2.2 ppm at Mile 2.5, 1.6 ppm and at Deer Rips Dam 1.4 ppm. The intermettent operation at Gulf Island Dam spread the 'lows' over a period of about four days; the probable real low was sometime on September eighteen.

LIVERMORE FALLS

April, June, 1970

Date	TEMP.	pH	D.O. ppm	D.O. % Sat.	D.O. lbs.	B.O.D. ppm	B.O.D. lbs/d
April							
30	6.3	6.3	13.7	100.0			
June							
1	18.0	6.8	8.1	85.3	149502	4.9	90439
2	18.7	6.7	8.1	86.3	149980	3.9	72212
3	21.1	6.8	7.0	77.8	137865	3.9	76811
4	20.8	6.7	8.2	91.0	150503	4.5	82593
5	20.4	6.7	7.4	80.3	129560	4.0	70032
8	17.4	6.6	8.2	84.6	169904	4.0	82880
9	18.8	6.7	8.0	85.3	169120	3.9	82446
10	20.3	6.5	7.9	85.8	151727	3.7	71063
11	21.0	6.6	6.9	76.6	123186	3.9	69627
12	22.0	6.5	7.1	80.7	120707	4.2	71404
15	19.8	6.7	7.2	78.3	114840	4.2	66990
16	20.2	6.7	7.0	76.2	112028	6.2	99225
17	21.0	6.6	7.1	78.8	112102	6.0	94734
18	21.5	6.9	6.6	75.0	102425	4.1	63628
19	21.8	6.7	6.2	70.4	95883	3.5	54128
22	19.8	6.8	6.8	73.8	97471	3.6	51602
23	21.8	6.6	7.2	81.8	101268	4.2	59073
24	21.0	6.5	7.2	80.0	98935	4.6	63209
25	21.5	6.6	6.9	78.4	89983	3.6	46948
26	21.8	6.6	6.6	75.0	84289	3.9	49807
29	17.9	6.7	7.8	82.2	125760	4.4	70941
30	18.5	6.5	7.8	83.0	111470	8.0	114330

LIVERMORE FALLS

July, 1970

Date	TEMP.	pH	D.O. ppm	D.O. % Sat.	D.O. lbs.	B.O.D. ppm	B.O.D. lbs/d
1	19.2	6.5	7.6	80.8	109676	8.4	121221
2	20.0	6.5	7.4	80.5	105753	8.4	120044
6	21.2	7.1	6.5	72.3	86340	4.2	55789
7	22.0	6.6	6.8	77.3	86143	4.8	60806
8	23.0	6.6	6.6	75.8	74897	4.3	48796
9	23.8	6.6	6.7	78.0	72863	7.3	79388
10	24.8	6.3	6.0	71.6	67866	7.4	83701
13	23.9	6.7	7.2	84.7	104954	7.8	113700
14	23.5	6.7	7.2	84.3	99943	6.5	90227
15	23.9	6.7	6.6	77.6	81517	6.1	75341
16	23.1	6.5	6.2	71.3	74071	6.4	76461
17	24.0	6.6	6.7	78.8	84085	5.7	71535
20	22.7	6.7	7.2	82.7	99554	6.4	88493
21	22.6	6.6	7.0	80.5	87892	5.5	69058
22	22.6	6.5	6.5	74.7	76037	5.2	60830
23	23.0	6.5	6.6	75.8	72488	6.6	72488
24	23.8	6.4	6.2	72.9	66755	5.3	57065
27	26.5	6.4	6.0	74.2	66060	4.7	51747
28	27.0	6.4	5.3	65.3	56980	3.6	38704
29	27.3	6.6	4.3	53.2	43890	3.3	33683
30	27.5	6.4	4.7	59.4	49844	3.2	33936
31	27.3	6.5	4.6	56.8	47720	3.3	34234

LIVERMORE FALLS

August, 1970

Date	Temp.	pH	D.O. ppm	D.O. % Sat.	D.O. lbs.	B.O.D. ppm	B.O.D. lbs/d
3	26.0	6.6	5.7	69.6	73103	2.9	37193
4	25.1	6.6	5.6	66.6	67777	5.9	71408
5	24.2	6.6	6.1	71.8	65551	5.6	60178
6	24.7	6.5	5.4	64.3	57121	5.0	52890
7	24.0	6.6	6.0	70.6	65994	5.1	56095
10	25.0	6.7	5.0	59.7	53945	5.5	59340
11	25.0	6.6	5.0	59.7	56045	Lost	-----
12	24.9	6.6	5.4	64.3	58229	Lost	-----
13	24.3	6.7	5.8	68.3	59920	Lost	-----
14	24.8	6.7	5.0	59.6	52810	Lost	-----
17	26.0	6.5	4.8	58.6	50722	Lost	-----
18	25.7	6.6	5.3	64.7	51611	5.2	50638
19	24.9	6.6	5.1	60.7	49414	4.9	47476
20	24.2	6.5	5.5	64.7	51398	6.0	56070
21	23.2	6.5	5.5	63.2	56733	5.7	58796
24	21.1	6.5	5.3	58.8	59206	6.8	75963
25	20.1	6.5	7.0	76.2	81662	7.0	81662
26	21.0	6.5	6.2	68.8	69862	8.7	99032
27	21.5	6.5	6.1	69.3	66666	6.6	72132
28	22.0	6.5	6.3	71.7	76217	8.9	107672
31	21.0	6.6	6.4	71.3	72563	6.6	74831

LIVERMORE FALLS

September, 1970

Date	TEMP.	pH	D.O. ppm	D.O. % Sat.	D.O. lbs.	B.O.D. ppm	B.O.D. lbs/d
1	20.1	6.5	6.4	69.6	70432	Lost	
2	19.0	6.6	7.4	78.7	78477	10.2	108171
3	18.0	6.6	7.1	74.7	72200	9.4	95589
4	18.5	6.6	7.3	77.7	80176	8.7	95552
7	Holiday	No Samples					
8	17.3	6.5	7.8	80.4	88600	6.6	74970
9	18.0	6.6	8.2	86.3	93324	6.2	70562
10	17.7	6.5	7.8	82.3	85285	3.6	39362
11	17.8	6.7	8.0	84.3	87824	6.2	68064
14	18.2	6.7	7.4	77.8	76168	8.6	88520
15	18.1	6.9	7.0	73.8	73451	10.6	111226
16	17.2	6.8	7.4	76.3	80512	9.9	107712
17	16.2	7.0	7.6	76.0	83957	8.2	90585
18	16.3	6.7	8.0	80.0	88232	7.8	86026
21	17.3	6.6	7.0	72.3	75446	10.5	113169
22	18.2	6.5	6.8	71.7	72706	6.3	67360
23	19.7	7.0	6.3	68.5	70816	9.9	111286
24	20.0	6.7	6.4	69.6	69152	8.4	90762
25	20.1	6.5	6.7	72.7	77445	9.6	110966

NORTH TURNER BRIDGE

May, June, 1970

Date	TEMP.	pH	D.O. ppm	D.O. % Sat.	D.O. lbs.	B.O.D. ppm	B.O.D. lbs/d
May							
7*	7.5	6.7	10.9	90.5	668894	3.9	239329
14*	11.0	6.7	10.1	91.0	590465	4.8	280617
21*	11.5	6.6	10.0	91.3	586452	4.5	263903
28*	12.2	6.7	9.0	83.6	224627	6.2	155743
30	15.0	6.6	8.8	82.5		3.2	
June							
1	17.8	6.5	8.3	86.0	160455	3.1	59929
2	19.0	6.4	7.3	77.5	139633	4.9	93726
3	20.2	6.6	6.9	75.0	143147	5.5	114103
4*	19.1	6.5	6.5	69.3	124560	5.4	103480
5	19.8	6.6	6.9	75.2	125423	5.7	103610
6	19.0	6.8	6.7	71.1	139722	5.3	110526
8	17.5	6.7	8.0	83.1	175753	4.3	94467
9	18.6	6.7	7.9	84.0	173655	4.0	87927
10	20.3	6.6	7.2	78.1	143833	4.0	79907
11*	19.2	6.5	6.5	69.4	120352	5.9	109242
12	22.0	6.7	6.1	69.5	106255	6.1	106254
13	20.9	6.7	6.1	67.9	106671	5.3	92681
15	20.0	6.9	6.4	69.8	103507	6.1	98655
16	21.0	6.7	6.5	72.3	106622	5.3	86938
17	21.1	6.7	6.1	70.0	98919	6.3	102162
18*	21.0	6.7	5.6	62.2	89341	5.9	94127
19	22.0	6.8	5.6	63.5	89281	5.7	90876
20	22.0	6.7	5.5	62.6	86158	5.8	90857
22	20.0	6.8	6.2	67.0	89403	5.5	79309
23	20.5	6.7	5.6	61.3	79868	6.3	89852
24	20.2	6.7	6.1	66.0	85575	5.8	81366
25*	20.0	6.7	5.7	62.0	74133	7.4	96243
26	20.0	6.6	5.7	61.9	70096	6.8	83623
27	19.9	6.7	5.8	62.7	93815	6.5	105138
29	18.0	6.8	7.0	74.1	121126	6.9	119396
30	18.9	6.7	6.7	70.8	97534	4.4	64052

*Oxford Data

NORTH TURNER BRIDGE

July, 1970

Date	TEMP.	pH	D.O. ppm	D.O. % Sat.	D.O. lbs.	B.O.D. ppm	B.O.D. lbs/d
1	18.5	6.6	6.6	70.1	98353	6.1	90902
2	19.4	6.6	6.3	67.6	91711	6.7	97534
3	19.3	6.7	6.1	65.2	79530	6.3	82138
4	19.9	6.9	5.4	59.2	72895	10.8	145790
6	20.5	6.9	6.4	70.5	87083	4.5	61230
7	21.5	7.0	5.6	63.0	71827	5.8	74392
8	22.0	6.7	6.0	68.2	68944	4.8	55155
9	22.8	6.8	4.8	55.0	52650	6.5	71297
10	24.1	6.7	4.4	51.7	50652	6.5	74828
11	25.0	6.6	3.8	44.6	47466	5.7	71199
13	23.0	6.8	5.1	58.5	78325	7.2	110577
14	23.0	6.7	5.4	62.3	77284	5.0	71559
15	22.1	6.7	5.5	62.4	69846	5.4	68576
16	22.2	6.8	4.3	49.0	52442	6.2	75614
17	22.1	6.7	4.2	47.6	53205	7.0	88676
18	23.0	6.7	5.2	59.7	73081	6.1	85730
20	22.0	6.8	5.6	63.6	80325	7.2	103276
21	22.2	6.7	5.3	60.7	68185	4.6	59179
22	21.2	6.8	5.1	56.8	60895	5.8	69253
23	21.5	6.7	4.2	47.2	46522	5.5	60922
24	23.5	6.7	4.2	48.4	45977	5.6	61302
25	24.1	6.6	4.1	48.5	45383	5.1	56452
27	26.0	6.7	3.8	46.6	42896	5.0	56442
28	26.5	6.6	3.5	43.0	38351	5.7	62458
29	27.0	6.7	3.0	37.1	31177	5.7	59237
30	26.6	6.6	2.3	28.3	24805	5.6	60395
31	27.1	6.6	3.1	37.9	32263	5.3	55160

NORTH TURNER BRIDGE

August, 1970

Date	Temp.	pH	D.O. ppm	D.O. % Sat.	D.O. lbs.	B.O.D. ppm	B.O.D. lbs/d
1	26.5	6.6	3.5	42.5	41283	5.2	61334
3	25.5	6.8	3.9	47.0	52331	4.7	63066
4	24.9	6.7	4.6	54.8	56334	3.3	40414
5	23.1	6.7	4.6	52.3	49498	4.3	46269
6	23.2	6.7	3.8	43.9	39851	5.9	61875
7	23.5	6.6	3.5	41.2	38342	5.3	58061
8	24.1	6.7	3.9	46.3	42580	5.2	56774
10	24.3	6.6	3.7	43.8	39827	5.6	60279
11	24.9	6.7	3.0	35.1	33437	5.2	57959
12	24.5	6.7	3.6	42.3	38351	5.0	53265
13	23.4	6.6	3.2	37.1	33292	6.8	70745
14	24.5	6.7	3.3	34.3	34643	6.0	62987
15	25.0	6.7	2.4	28.8	24818	6.1	63080
17	25.8	6.7	3.3	40.3	33874	5.1	52351
18	24.1	6.6	2.6	30.5	24769	5.1	48585
19	23.8	6.7	2.7	31.8	25876	5.4	51752
20	23.6	6.6	2.4	28.0	22248	5.8	53768
21	22.8	6.6	3.2	36.5	32500	5.5	55860
22	21.9	6.7	3.4	38.1	35438	6.1	63580
24	20.3	6.7	4.5	49.6	48978	5.4	58774
25	20.2	6.6	3.8	41.7	45127	6.0	71253
26	20.8	6.7	4.4	49.1	49390	6.6	74085
27	21.1	6.7	4.0	44.5	43747	4.8	52497
28	21.0	6.6	4.2	46.7	50608	5.9	71092
29	21.2	6.7	4.4	49.0	50692	5.2	59908
31	21.0	6.7	4.6	51.3	53533	5.4	62843

NORTH TURNER BRIDGE

September, 1970

Date	Time	Temp.	pH	D.O. ppm	D.O. % Sat.	D.O. lbs/d	B.O.D. ppm	B.O.D. lbs/d
1		19.0	6.7	4.3	45.9	47214	6.2	68077
2		18.1	6.7	4.7	49.9	50284	7.2	77032
3*		17.0	6.8	4.9	50.5	49763	7.7	78199
4		18.1	6.7	4.4	45.7	48738	7.9	87507
5		18.0	6.9	4.3	45.2	51114	9.2	109360
7		18.0	6.8	5.1	53.6	59479	7.4	86304
8	9 am	18.0	6.9	5.2	54.2	59565	8.2	93930
	7 pm	18.1	7.0	5.0	52.6	56605	7.1	80379
9	9 am	18.0	6.6	6.6	69.6	74964	3.3	37482
	5 pm	18.0	6.7	7.3	77.2	80921	2.1	23279
10*	7am	17.1	6.8	7.0	72.3	77336	3.4	37563
	5 pm	18.0	6.7	7.1	74.5	77596	2.4	26230
11	9 am	17.5	6.7	7.1	74.3	77856	2.9	31800
	7 pm	18.9	6.9	6.9	73.2	75486	2.6	28444
12	9 am	16.9	6.9	6.6	68.0	70600	4.4	47067
	7 pm	18.9	7.1	5.6	59.3	59903	9.6	102691
14	9 am	18.0	7.1	5.4	56.6	56295	8.3	86528
15	9 am	17.0	6.9	5.5	56.7	58111	6.4	67621
16		17.0	7.0	5.3	54.7	62048	7.2	79776
17*		15.5	7.0	5.4	53.5	60842	8.6	96897
18		16.8	7.0	6.0	61.7	68574	8.1	92576
19		15.5	7.1	6.3	62.4	71096	7.0	78995
24		18.3	7.0	3.8	40.1	38824	8.0	

*Oxford data.

TURNER CENTER BRIDGE

May, June, 1970

Date	TEMP.	pH	D.O. ppm	D.O. % Sat.	D.O. lbs.	B.O.D. ppm	B.O.D. lbs/d
May							
7*	7.5	6.6	10.7	88.8	725138	3.3	223640
14*	11.3	6.7	9.7	88.1	598179	4.5	277505
21*	11.5	6.6	9.8	89.5	606992	3.5	216782
28*	13.0	6.7	8.4	79.2	220449	5.3	139093
30	16.0	6.4	8.1	81.0		2.8	
June							
1	18.0	6.4	7.2	75.6	148132	3.2	65836
2	18.8	6.5	6.6	70.5	131867	4.2	83915
3	20.8	6.4	6.0	66.7	133487	4.4	97891
4*	19.5	6.5	5.8	62.4	117763	4.5	91367
5	20.5	6.5	5.8	64.0	110872	4.8	91756
6	19.5	6.6	5.9	63.0	132237	4.7	105341
8	19.0	6.7	6.6	70.0	156815	4.2	99791
9	19.3	6.6	6.8	72.7	157528	3.2	74131
10	20.4	6.6	6.5	71.5	136889	2.9	61073
11*	20.0	6.5	5.7	62.0	110807	3.4	66095
12	22.2	6.6	5.1	58.7	93506	4.6	82717
13	21.9	6.5	4.4	49.9	81070	5.4	99495
15	21.0	6.6	4.6	50.9	77252	4.6	77252
16	21.0	6.6	4.0	43.9	68039	5.3	90152
17	21.5	6.5	4.2	46.8	70534	4.4	73893
18*	21.0	6.6	4.2	46.7	68947	5.1	83721
19	21.5	6.5	2.8	31.9	45813	5.1	83446
20	21.5	6.5	2.8	31.6	45856	4.6	75334
22	21.0	6.5	3.6	40.3	54043	4.6	69055
23	21.0	6.5	4.0	44.4	58319	5.1	74357
24	21.5	6.6	3.4	38.5	48286	4.8	68169
25*	20.7	6.5	3.8	41.9	50684	5.2	69357
26	21.0	6.5	3.2	35.4	39398	5.3	56253
27	20.0	6.5	3.7	40.2	61990	5.4	90472
29	19.5	6.7	4.6	49.8	87436	5.9	112147
30	18.9	6.7	5.9	63.1	87933	5.4	80481

TURNER CENTER BRIDGE

July, 1970

Date	TEMP.	pH	D.O. ppm	D.O. % Sat.	D.O. lbs.	B.O.D. ppm	B.O.D. lbs/d
1	19.1	6.5	4.8	51.5	74649	4.6	71539
2	19.1	6.5	4.8	51.2	71539	5.0	74519
3	19.5	6.5	4.4	47.3	59399	4.7	63449
4	19.9	6.6	4.6	50.5	65417	4.6	65417
6	20.5	6.6	2.9	31.8	40715	5.2	73007
7	22.0	6.6	3.8	43.7	49453	3.2	41644
8	22.1	6.8	3.3	37.9	38491	3.7	43156
9	22.8	6.7	3.7	42.4	40958	4.8	53135
10	24.1	6.5	2.8	32.5	32961	4.6	54151
11	25.0	6.6	2.4	28.5	30506	3.8	48302
13	24.0	6.5	1.6	19.1	26351	5.5	90584
14	23.8	6.6	2.1	24.8	31298	5.7	84952
15	23.5	6.5	3.4	39.8	44798	4.6	60609
16	23.0	6.6	3.5	40.2	43847	4.6	57628
17	23.0	6.6	2.9	33.5	37114	6.2	79347
18	23.0	6.5	2.5	29.1	37708	5.0	75415
20	23.0	6.5	2.5	29.0	37664	5.2	78343
21	23.0	6.6	2.7	30.6	35866	6.3	83689
22	22.9	6.6	2.6	29.8	31870	4.8	58838
23	22.5	6.5	2.4	27.4	26827	3.5	39122
24	23.8	6.5	2.0	24.0	22355	5.4	60361
25	24.5	6.5	1.4	16.6	16061	5.0	57360
27	26.1	6.4	1.6	19.8	18662	4.2	48988
28	26.8	6.5	1.2	14.7	13478	4.5	50543
29	27.2	6.5	1.2	14.8	12765	3.9	41448
30	27.0	6.5	1.2	14.8	13219	3.9	42962
31	27.5	6.4	0.4	5.4	4168	4.4	45856

TURNER CENTER BRIDGE

August, 1970

Date	Temp.	pH	D.O. ppm	D.O. % Sat.	D.O. lbs.	B.O.D. ppm	B.O.D. lbs/d
1	27.1	6.5	0.75	9.3	9264	4.0	49408
3	26.0	6.6	1.3	16.4	18532	4.0	57123
4	26.2	6.5	0.68	8.3	7451	3.6	44711
5	25.2	6.5	0.96	11.4	9611	3.4	36536
6	24.1	6.5	1.4	16.5	14439	3.2	33004
7	24.1	6.4	1.1	13.4	11939	3.4	36903
8	24.2	6.5	0.58	6.8	6593	3.6	39557
10	24.9	6.5	0.82	9.8	8553	4.0	42767
11	25.0	6.4	0.61	7.3	6609	3.7	40759
12	25.0	6.5	0.57	6.8	6253	3.8	39603
13	24.0	6.4	0.4	4.7	4190	4.8	50284
14	24.9	6.4	0.8	9.4	8294	4.1	42508
15	25.1	6.4	0.7	8.2	7277	4.0	41580
17	26.2	6.5	0.4	5.0	3909	4.4	43005
18	25.5	6.4	0.11	1.3	917	3.5	32129
19	24.8	6.7	0.4	5.0	3758	3.7	34765
20	24.0	6.5	0.4	4.7	3650	3.9	35511
21	23.9	6.5	0.32	3.8	2964	4.3	42492
22	23.0	6.5	0.26	3.0	3102	3.8	39296
24	21.9	6.5	0.78	8.9	8337	4.3	44814
25	20.9	6.6	1.7	19.3	20654	3.9	47384
26	21.1	6.6	1.8	19.6	20023	4.0	44495
27	22.1	6.6	2.4	26.8	26179	4.1	44722
28	22.1	6.5	2.1	23.7	25061	3.9	44155
29	21.9	6.5	2.5	27.4	31108	3.2	39818
31	21.8	6.5	2.4	27.1	28900	4.2	50576

TURNER CENTER BRIDGE

September, 1970

Date	Time	Temp.	pH	D.O. ppm	D.O. % Sat.	D.O. lbs/d	B.O.D. ppm	B.O.D. lbs/d
1		20.5	6.6	2.7	29.8	29451	4.1	44722
2		19.8	6.6	3.1	34.1	33479	3.5	37799
3*		18.0	6.7	3.0	31.6	30293	3.0	50489
4		18.9	6.5	3.3	35.4	36887	5.5	61478
5		18.5	6.6	2.8	29.6	33487	5.5	65764
7		18.9	6.6	2.6	28.2	32659	8.3	100396
8		18.3	6.6	3.4	35.6	39290	6.9	79736
9		18.3	6.6	3.1	32.8	34996	5.0	56429
10*		17.2	6.8	2.9	30.3	32416	5.1	57007
11	9 am	17.9	6.6	5.6	59.1	61084	1.9	20725
	7 pm	18.5	6.7					
12	9 am	17.5	6.7	5.8	59.8	62164	2.2	23590
12	6:30 pm	18.0	6.7	6.0	63.4	64308	2.1	22508
14		18.0	6.8	3.9	41.1	41277	5.2	55036
15		18.0	7.3	0.7	7.8	7446	11.7	124464
16		17.4	6.9	3.0	30.8	34019	5.1	57833
17*		15.8	6.9	3.7	36.9	42757	6.2	71647
18		17.1	6.8	3.9	40.5	45700	5.8	67964
19		16.5	7.0	4.0	40.2	46748	6.5	75966
24		18.8	6.7	3.5	37.2	36383	5.1	

*Oxford data

MILE 4.25

May, June, 1970

Date	TEMP.	pH	D.O. ppm	D.O. % Sat.	D.O. lbs	B.O.D. ppm	B.O.D. lbs/d
May 30	15.9	6.51	7.3	73.2		2.6	
June 6	19.5	6.40	4.2	45.2		4.9	
8	19.9	6.68	4.9	53.5	116179	4.2	99582
9	21.0	6.55	5.2	57.6	120214	3.3	76290
10	21.0	6.51	5.1	56.5	107182	3.4	71760
12	22.0	6.35	2.5	28.3	44863	4.4	78958
13	22.0	6.30	3.1	35.4	57133	4.9	90307
15	23.0	6.43	5.7	65.2	95526	4.5	75416
16	22.5	6.49	2.4	27.5	40738	4.6	78081
17	22.5	6.50	2.1	24.0	35194	4.9	82119
19	22.5	6.31	0.7	7.6	10777	5.5	89804
20	22.5	6.55	1.0	11.3	16382	4.5	73674
22	21.8	6.38	0.5	5.4	7041	4.8	71909
23	22.5	6.40	1.6	18.6	23280	4.7	68385
24	22.2	6.49	1.7	19.4	24094	4.5	63779
26	21.5	6.39	1.2	13.2	14743	5.2	63887
27	20.5	6.40	1.2	12.7	20111	5.1	85471
29	20.5	6.40	2.9	31.6	55010	5.2	98639
30	20.0	6.59	4.4	47.9	65441	5.4	80314

MILE 4.25

July, 1970

Date	TEMP.	pH	D.O. ppm	D.O. % Sat.	D.O. lbs.	B.O.D. ppm	B.O.D. lbs/d
1	20.0	6.5	3.3	35.9	51213	5.1	79147
3	20.0	6.4	2.6	28.7	35027	4.4	59277
4	20.8	6.5	2.3	25.9	32722	3.7	52825
6	21.0	6.4	2.0	10.9	28022	4.5	63050
7	21.9	6.5	1.3	14.3	16883	4.8	62338
8	23.0	6.5	2.0	22.7	23278	2.9	33753
10	24.2	6.6	1.1	12.6	12922	3.2	37590
11	24.9	6.5	0.3	3.1	3306	2.9	36880
13	24.1	6.4	0.0	0.0	0	3.8	62453
14	24.5	6.5	0.1	0.7	892	3.3	49081
15	24.0	6.5	0.6	7.2	8021	5.4	71005
17	23.1	6.4	1.3	15.3	16602	4.3	54915
18	24.0	6.4	0.9	10.2	12976	4.9	73931
20	23.2	6.4	0.2	2.3	3007	4.4	66154
21	23.5	6.5	0.9	10.5	11931	4.4	58327
22	23.2	6.4	1.1	12.6	13455	5.2	63607
24	24.5	6.4	0.1	1.7	1562	3.8	42389
25	24.2	6.3	0.2	2.0	1951	4.1	47060
27	25.8	6.3	0.0	0.0	0	4.1	47720
28	26.2	6.3	0.0	0.0	0	4.0	44836
29	26.5	6.3	0.0	0.0	0	4.4	46710
31	27.5	6.3	0.1	1.1	936	3.6	37444

MILE 4.25

August, September, 1970

Date	Temp.	pH	D.O. ppm	D.O. % Sat.	D.O. lbs/d	B.O.D. ppm	B.O.D. lbs/d
1	27.0	6.4	0.26	3.2	3208	3.7	45658
3	27.1	6.5	0.07	0.9	996	3.3	46950
4	26.2	6.4	0.03	0.4	372	3.0	37182
5	26.0	6.4	0.03	0.4	322	3.3	35390
7	25.1	6.3	0.07	0.8	758	2.3	24914
8	25.1	6.4	0.04	0.5	440	2.3	25287
10	25.8	6.4	0.08	1.0	854	2.0	21340
11	25.9	6.4	0.17	2.1	1860	2.5	27350
12	24.8	6.4	0.14	1.7	1456	3.6	37444
14	25.5	6.4	0.0	0	0	3.8	39319
15	25.8	6.4	0.08	1.0	832	2.9	30163
17	26.0	6.4	0	0	0	3.3	32188
18	25.0	6.3	0	0	0	5.6	51302
19	25.1	6.4	0	0	0	3.6	33757
20	24.1	6.4	0	0	0	3.2	31558
22	24.0	6.4	0	0	0	3.2	33110
24	22.5	6.5	0	0.5	0	3.1	32243
25	22.8	6.4	0	0.7	0	3.3	40009
26	22.5	6.5	0.15	1.7	2220	3.1	34414
28	22.1	6.4	0.43	4.9	4764	3.1	36918
29	22.5	6.5	0.42	4.8	4979	2.6	32365
31	21.5	6.4	0.63	7.1	7210	2.7	32446
September							
1	No samples - High Wind - Rough Water						
2	20.0	6.5	1.29	14.1	13100	3.3	33254
4	18.9	6.4	2.0	20.7	22210	4.1	45736
5	19.9	6.5	1.3	14.4	15552	4.2	50245
7	19.0	6.5	1.1	11.2	13278	3.8	45870
8	18.1	6.6	0.6	6.3	6920	6.1	70345
9	18.0	6.6	1.2	12.7	13516	5.6	63073
11	18.1	6.6	2.0	20.6	21772	3.7	40278
12	18.0	6.6	3.1	32.6	33244	2.2	23593
14	17.8	6.6	4.4	46.0	46473	2.3	24293
15	16.5	6.7	2.7	27.0	28663	3.8	40341
16	17.0	7.1	0.02	0.2	226	7.1+	80344
18	16.2	6.8	2.4	23.7	28066	4.9	57300
19	16.5	6.8	2.1	21.2	24558	4.5	52173

MILE 2.5

May, June, 1970

Date	TEMP.	pH	D.O. ppm	D.O. % Sat.	D.O. lbs.	B.O.D. ppm	B.O.D. lbs/d
May							
30	16.0	6.4	6.9	69.2		2.5	
June							
6	19.5	6.3	3.0	32.3		4.7	
8	20.5	6.5	3.7	40.8	87727	3.8	90098
9	21.0	6.5	4.2	46.7	97096	3.3	76290
10	22.0	6.5	3.9	44.2	81962	3.2	67251
12	22.5	6.4	3.4	38.6	61013	3.2	57424
13	21.5	6.3	2.1	23.6	38703	3.6	66348
15	22.5	6.3	3.3	38.0	55305	3.6	60333
16	23.0	6.4	1.5	17.3	25461	2.5	42435
17	23.0	6.4	1.3	14.4	21787	4.2	70388
19	23.0	6.4	0.1	0.6	816	3.3	53883
20	23.0	6.4	2.0	23.4	32764	4.8	78634
22	22.0	6.4	0.1	0.9	1199	4.1	61422
23	22.5	6.4	0.0	0.3	436	4.7	67915
24	22.5	6.3	0.1	1.5	1843	4.7	66613
26	22.0	6.3	0.0	0.5	492	5.6	68802
27	21.0	6.3	0.1	1.4	2179	6.1	102230
29	20.9	6.3	0.2	2.5	4173	4.5	85361
30	20.5	6.3	0.5	5.6	7585	3.8	56517

MILE 2.5

July, 1970

Date	TEMP.	pH	D.O. ppm	D.O. % Sat.	D.O. lbs.	B.O.D. ppm	B.O.D. lbs/d
1	20.9	6.3	0.8	8.9	12415	4.0	62076
3	20.8	6.4	0.8	8.3	10104	2.7	36374
4	20.9	6.4	0.7	7.8	9959	2.8	39836
6	21.0	6.4	0.8	9.0	11209	2.7	37830
7	21.9	6.4	1.3	14.4	16883	4.5	58442
8	22.5	6.3	0.2	2.7	2328	3.6	41900
10	23.9	6.4	0.3	3.1	3054	3.8	44639
11	24.0	6.4	0.0	0.3	382	3.3	41966
13	24.0	6.4	0.0	0.0	0	1.9	31227
14	24.5	6.4	0.0	0.4	446	2.6	38670
15	24.0	6.5	0.1	1.1	1183	4.5	59171
17	24.0	6.4	0.1	1.1	1150	4.3	54916
18	24.5	6.4	0.0	0.5	604	2.5	37720
20	23.5	6.3	0.0	0.5	602	3.8	57133
21	23.9	6.4	0.1	1.2	1326	3.1	41094
22	23.2	6.3	0.1	0.9	979	3.6	44035
24	24.0	6.4	0.1	0.8	781	3.7	41274
25	24.5	6.3	0.1	0.9	918	3.7	42469
27	25.2	6.3	0.0	0.0	0	3.7	43064
28	25.8	6.3	0.0	0.0	0	6.1	68375
29	26.0	6.4	0.0	0.0	0	4.6	48834
31	27.2	6.3	0.0	0.0	0	2.2	22882

MILE 2.5

August, September, 1970

Date	Temp.	pH	D.O. ppm	D.O. % Sat.	D.O. lbs/d	B.O.D. ppm	B.O.D. lbs/d
1	26.8	6.4	0.03	0.4	370	3.0	37020
3	27.0	6.4	0	0	0	3.9	55485
4	26.3	6.4	0	0	0	3.9	48337
5	26.0	6.3	0	0	0	4.5	48258
7	25.8	6.3	0	0	0	3.4	36829
8	25.5	6.3	0	0	0	3.1	34082
10	25.5	6.3	0	0	0	2.9	30943
11	25.9	6.3	0	0	0	3.4	37196
12	25.0	6.3	0	0	0	2.6	27043
14	25.5	6.3	0	0	0	4.1	42423
15	25.5	6.3	0	0	0	3.4	35363
17	25.1	6.3	0	0	0	3.9	38041
18	24.5	6.3	0	0	0	3.6	32980
19	24.9	6.3	0	0	0	3.8	35633
21	24.2	6.3	0	0	0	4.4	43393
22	24.5	6.2	0	0	0	3.9	40353
24	23.5	6.4	0	0	0	3.9	40564
25	23.2	6.4	0	0	0	3.7	44859
26	23.1	6.3	0	0	0	3.4	37743
28	23.1	6.3	0.1	1.0	1191	2.6	30963
29	23.0	6.4	0.1	0.7	1245	2.3	28630
31	22.0	6.4	0.1	1.4	1202	2.2	26437
September							
1	No Samples - High Wind - Rough Water						
2	20.5	6.3	0.13	1.4	1310	2.6	26200
4	20.2	6.4	0.24	2.6	2677	2.4	26772
5	20.5	6.3	0.15	1.6	1795	2.4	28711
7	19.5	6.4	0.20	2.2	2414	2.1	25350
8	19.0	6.5	0.05	0.5	577	2.9	33443
9	18.8		0.08	0.9	901	3.0	33789
11	18.8	6.5	0.08	0.9	871	3.3	35924
12	18.5	6.4	0.10	1.1	1072	2.9	31100
14	18.1	6.4	0.8	8.8	8450	1.7	17956
15	17.0	6.4	2.0	20.9	21232	1.6	16986
16	17.3	6.5	1.8	18.3	20369	1.7	19237
17	17.5	6.6	0.1	1.0	1153		
18	17.0	6.6	0.08	0.8	936	3.6	42100
19	16.9	6.6	0.07	0.7	819	3.4	39760

GULF ISLAND DAM

May, June, 1970

Date	TEMP.	pH	D.O. ppm	D.O. % Sat.	B.O.D. ppm
May					
7*	8.0	6.5	10.5	88.2	1.8
14*	11.5	6.6	8.8	80.4	1.7
21*	11.5	6.5	9.3	84.9	2.3
28*	14.3	6.5	6.7	64.8	2.3
30	14.5	6.3	6.2	60.0	2.0
June					
1	18.0	6.3	6.7	70.7	
2	19.0	6.2	6.1	64.9	
3	18.0	6.3	5.1	53.8	
4*	19.2	6.6	5.1	54.5	2.7
5	20.0	6.4	4.3	46.3	
6	19.5	6.3	3.2	34.7	2.9
8	20.8	6.4	2.6	28.6	
9	20.5	6.3	1.6	17.3	
10	19.7	6.3	2.4	25.9	
11*	21.3	6.3	1.6	17.9	2.6
12	23.0	6.5	3.2	37.2	
13	22.0	6.4	3.2	36.2	1.9
15	21.9	6.2	2.1	24.0	
16	21.6	6.2	1.1	11.8	
17	22.1	6.3	0.8	8.7	
18*	22.3	6.4	0.4	4.6	3.6
19	22.4	6.3	1.3	14.6	
20	22.4	6.3	1.3	14.5	2.9
22	22.0	6.3	1.2	13.4	
23	22.0	6.2	1.0	11.3	
24	22.1	6.3	0.7	8.0	
25*	22.0	6.3	0.2	2.3	5.0
26	22.3	6.4	1.1	12.9	
27	21.7	6.4	1.7	19.6	3.5
29	21.2	6.3	1.6	17.3	
30	20.6	6.2	1.1	12.1	

*Oxford Paper Data

GULF ISLAND DAM

July, 1970

Date	TEMP.	pH	D.O. ppm	D.O. % Sat.	B.O.D. ppm
1	20.8	6.3	0.2	2.3	
2	20.4	6.3	1.0	11.0	4.5
3	20.3	6.3	1.4	15.3	
4	19.9	6.4	1.6	17.4	3.5
6	20.7	6.4	1.8	19.7	
7	21.7	6.4	2.0	22.8	
8	21.0	6.4	1.5	16.2	
9	21.8	6.4	1.0	11.3	2.6
10	22.8	6.3	1.7	19.4	
11	22.9	6.4	1.6	18.6	1.6
13	23.8	6.4	1.7	19.9	
14	24.1	6.5	1.3	15.3	
15	23.8	6.4	1.2	13.5	
16	23.8	6.5	0.7	8.2	2.4
17	23.7	6.5	0.9	10.0	
18	23.6	6.4	1.0	11.6	2.9
20	23.5	6.3	0.8	9.6	
21	23.4	6.4	0.7	8.1	
22	23.3	6.3	0.9	10.0	
23	23.6	6.5	1.0	11.7	2.6
24	23.8	6.4	0.8	8.3	
25	23.5	6.4	0.7	8.7	2.0
27	24.2	6.3	1.2	13.7	
28	24.7	6.3	1.5	17.5	
29	25.8	6.4	1.5	18.3	
30	26.2	6.5	1.6	19.6	2.3
31	26.2	6.3	1.3	15.5	

GULF ISLAND DAM

August, September, 1970

Date	Temp.	Ph	D.O. ppm	D.O. % Sat.	B.O.D. ppm
1	26.00	6.4	1.20	14.6	2.6
3	26.36	6.4	1.08	13.2	
4	26.38	6.4	0.81	9.9	
5	26.10	6.3	0.87	10.6	
6*	25.7	6.4	0.3	3.6	3.1
7	25.50	6.3	0.69	8.3	
8	25.39	6.3	0.66	7.9	2.9
10	25.30	6.3	1.08	13.0	
11	25.12	6.2	0.80	9.5	
12	25.13	6.3	1.07	12.6	
13*	25.1	6.4	0.3	3.6	2.8
14	24.97	6.4	0.83	9.9	
15	24.89	6.3	1.0	12.4	2.5
17	24.98	6.2	0.5	6.1	
18	25.48	6.3	1.5	17.6	
19	25.20	6.3	1.0	11.5	
20*	24.9	6.5	0.8	9.5	2.6
21	24.70	6.3	0.7	7.9	
22	24.52	6.4	1.0	11.1	2.1
24	23.90	6.3	0.8	9.8	
25	23.63	6.4	0.9	10.0	
26	23.29	6.4	0.8	9.4	
27*	22.9	6.5	0.7	8.0	2.7
28	23.07	6.3	0.7	8.4	
29	22.49	6.4	1.0	11.1	2.6
31	22.12	6.3	1.0	11.0	
September					
1	21.2	6.5	1.0	11.3	
2	21.21	6.5	1.8	20.0	
3*	21.0	6.6	1.8	20.0	2.0
4	20.58	6.4	1.3	14.6	
5	20.30	6.4	1.2	12.5	2.5
7	19.79	6.5	1.8	19.5	
8	19.49	6.3	1.7	18.0	
9	19.32	6.3	1.2	12.7	
10*	19.0	6.5	0.9	9.6	3.2
11	18.75	6.6	1.2	12.3	
12	18.63	6.4	1.1	11.1	3.5
14	18.36	6.4	0.9	9.8	
15	18.16	6.5	2.0	20.5	
16	18.00	6.4	0.7	7.6	
17*	16.9	6.5	0.1	1.0	2.5
18	17.8	6.5	0.4	4.0	
19	17.0	6.5	0.4	4.1	2.1
24*	18.3	6.7	0.8	8.4	2.3

*Oxford data

DEER RIPS DAM

May, June, 1970

Date	TEMP.	pH	D.O. ppm	D.O. % Sat.	D.O. lbs.	B.O.D. ppm	B.O.D. lbs/d
May							
7*	7.5	6.6	11.4	94.6		1.9	
14*	11.5	6.6	10.3	94.1		1.9	
21*	11.5	6.5	10.6	96.8		1.8	
28*	14.3	6.5	7.1	68.7		2.3	
30*	15.0	6.3	6.4	63.0		2.1	
June							
1	16.0	6.2	6.3	62.9	129314	2.1	43115
2	17.2	6.2	5.7	58.5	113647	2.7	51839
3	17.5	6.3	5.2	54.3	115419	2.8	62166
4*	18.2	6.5	4.9	51.7	99279	2.8	56731
5	19.0	6.3	4.2	44.7	80123	3.0	57231
6	19.0	6.4	3.5	37.4	77518	3.0	66444
8	20.0	6.4	2.4	26.4	56904	2.9	68759
9	19.7	6.3	2.0	22.2	44236	3.2	73978
10	20.0	6.4	2.4	26.3	50439	2.9	60946
11*	19.5	6.3	2.4	25.8	46558	2.6	50437
12	20.8	6.5	2.8	30.8	50246	2.2	39479
13	21.0	6.3	2.5	28.0	46075	1.8	33174
15	20.0	6.2	1.3	13.9	21787	1.7	28490
16	22.0	6.2	0.9	10.0	15616	2.7	45830
17	22.0	6.3	0.9	10.0	15418	2.7	45250
18*	21.3	6.3	0.5	5.6	8191	2.6	42593
19	22.5	6.3	0.7	8.1	11593	2.8	45718
20	22.5	6.3	0.9	10.4	14908	3.2	52422
22	21.9	6.3	0.7	8.7	11535	2.4	35954
23	22.5	6.3	0.3	3.4	4365	3.8	54910
24	22.0	6.3	0.1	0.9	1134	4.6	65196
25*	21.2	6.3	0.0	0.0	0	5.1	67881
26	22.5	6.3	0.5	5.9	6389	3.5	43000
27	21.0	6.4	1.1	12.1	18435	2.9	48601
29	21.1	6.3	0.6	6.5	11381	3.2	60700
30	20.0	6.3	0.4	4.7	6395	4.7	69903

*Oxford Data

DEER RIPS DAM

July, 1970

Date	TEMP.	pH	D.O. ppm	D.O. % Sat.	D.O. lbs.	B.O.D. ppm	B.O.D. lbs/d
1	21.2	6.3	0.6	6.6	9312	3.7	57420
2	20.0	6.3	0.5	5.4	7436	3.6	53543
3	20.5	6.4	0.8	8.9	10912	3.4	45805
4	20.0	6.4	0.3	3.5	4553	2.9	41259
6	20.9	6.4	0.9	10.4	13170	2.5	35028
7	21.2	6.4	0.8	9.3	10909	2.5	32468
8	21.2	6.3	0.8	8.7	9078	2.3	26770
9	21.0	6.3	0.2	2.2	2210	2.6	28722
10	22.0	6.3	0.6	6.5	7048	2.9	34066
11	22.0	6.3	0.2	2.8	2544	1.9	24162
13	23.0	6.4	0.7	7.9	11505	2.4	39444
14	23.5	6.4	0.5	6.1	7437	2.6	38670
15	23.5	6.4	0.4	5.0	5260	2.5	32873
16	23.2	6.5	0.1	1.2	1250	2.2	27505
17	24.0	6.5	0.4	4.1	5109	2.7	34482
18	24.0	6.4	0.1	1.2	1509	2.4	36211
20	23.1	6.3	0.1	1.6	2105	2.7	40595
21	23.5	6.5	0.1	1.1	1326	3.2	42420
22	23.5	6.3	0.2	2.6	2691	2.5	30580
23	23.0	6.4	0.1	1.1	1116	2.8	31234
24	24.5	6.4	0.2	2.8	2231	2.9	32350
25	24.0	6.4	0.1	1.2	1148	2.8	32139
27	24.0	6.3	0.0	0.0	0	3.5	40737
28	24.5	6.3	0.1	1.3	1121	3.2	35869
29	24.5	6.3	0.3	3.6	3185	3.4	36095
30	24.7	6.4	0.0	0.0	0	2.8	30783
31	25.0	6.2	0.1	1.2	1040	3.3	34323

DEER RIPS DAM

August, 1970

Date	Temp.	pH	D.O. ppm	D.O. % Sat.	D.O. lbs/d	B.O.D. ppm	B.O.D. lbs/d
1	24.8	6.3	0	0	0	3.6	44424
3	26.0	6.3	0.08	1.0	1138	2.7	38413
4	26.2	6.4	0.24	2.9	2975	2.3	28506
5	26.0	6.3	0.21	2.6	2252	2.4	25738
6*	25.0	6.4	0.3	3.6	3088	4.4	45289
7	25.5	6.4	0.24	2.9	2600	2.7	29247
8	25.5	6.3	0.04	0.5	440	2.9	31883
10	25.1	6.2	0.12	1.4	1280	3.4	36278
11	25.5	6.3	0.29	3.5	3282	2.7	29538
12	24.5	6.3	0.31	3.7	3224	1.8	18722
13*	24.4	6.4	0.2	2.4	2091	2.4	25092
14	25.5	6.3	0.16	1.9	1655	2.2	22753
15	25.1	6.3	0	0	0	2.7	28083
17**	25.9	6.2	0	0	0	3.7	36090
18**	24.2	6.3	0.17	2.0	1832	2.4	21986
19**	25.0	6.3	0.49	5.8	4689	1.2	11252
*20**	24.0	6.5	0.2	2.4	1821	2.2	20035
21**	24.5	6.3	0.07	0.8	690	2.3	22683
22**	---Deer Rips Pool "dry"						
24**	23.2	6.4	0.49	5.6	5200	1.8	18722
25**	23.0	6.4	0.10	1.3	1212	2.3	27885
26**	23.0	6.3	0.10	1.3	1110	3.3	36633
*27**	22.0	6.4	0.1	1.1	1089	3.0	32658
28**	22.5	6.3	0.2	1.9	2382	2.3	27391
29**	22.1	6.3	0.2	2.3	2490	2.1	26141
31**	22.0	6.3	0.8	9.6	9614	1.7	20429

*Oxford data
**Lewiston side

DEER RIPS DAM

September, 1970

Date	Temp.	pH	D.O. ppm	D.O. % Sat.	D.O. lbs/d	B.O.D. ppm	B.O.D. lbs/d
1	21.1	6.5	1.5	16.1	16167	1.4	15089
2	21.1	6.5	1.7	19.1	17131	1.5	15116
3*	20.0	6.6	1.8	19.6	18139	1.9	19146
4	20.5	6.4	1.0	11.0	11155	1.8	20079
5	21.0	6.4	1.0	11.5	11963	1.5	17945
7	19.5	6.4	1.4	14.7	16900	2.3	27763
8	19.6	6.3	2.5	23.6	28830	1.9	21911
9	19.3	6.3	1.5	15.8	16895	1.5	16895
10*	19.0	6.4	0.6	6.4	6693	2.9	32350
11	19.0	6.4	0.2	12.9	2177	3.5	38101
12	19.0	6.3	0.3	3.6	3217	2.9	31100
14	18.3	6.4	0.8	8.8	8450	2.4	25349
15	18.0	6.5	0.9	9.3	9555	1.9	20180
16	17.9	6.4	0.9	9.2	10184	1.4	15842
17*	16.9	6.5	0.8	8.2	9226	2.0	23064
18	17.5	6.4	0.8	8.2	9355	1.6	18710
19	17.5	6.5	0.5	5.4	5847	2.0	23390
21	17.0	6.6	0.06	0.7	689	3.8	43616
22	17.5	6.6	0.4	4.0	4355	3.2	348352
24	17.3	6.7	0.5	5.2	5200	2.4	

Methylene Blue Stability

Mile 4.25

Date	Stability	D.O. ppm
July 20	7 days	0.20
22	7+ days	1.10
24	5 days	0.14
25	47 hours	0.17
27	14 hours	0
28	10 hours	0
29	14 hours	0
31	28 hours	0.1
Aug. 1	7 days	0.26
3	23 hours	0.07
4	4 days	0.03
5	3 days	0.03
7	36 hours	0.07
8	5 days	0.04
10	28 hours	0.08
11	52 hours	0.17
12	58 hours	0.14
14	6 days	0
15	7 hours	0.08
17	13 hours	0
18	36 hours	0
19	24 hours	0
21	48 hours	0.02
22	4.5 days	0
24	3.5 days	0.04
25	3.8 days	0.06
26	3.3 days	0.15
28	5.2 days	0.43
29	6.5 days	0.42
31	7.5 days	0.63
Sept. 2	8 days	1.29
4	7 days	1.95
5	5 days	1.32
7	7.3 days	1.05
8	6 days	0.60
9	6 days	1.20
11	8 days	1.96
12	14 days	3.10

Methylene Blue Stability

Mile 2.5

Date	Stability	D.O. ppm
July 20	30 hours	0.04
22	3 days	0.08
24	28 hours	0.07
25	14 hours	0
27	10 hours	0
28	9 hours	0
29	16 hours	0
31	14 hours	0.03
Aug. 1	14 hours	0
3	9 hours	0
4	9 hours	0
5	7 hours	0
7	6 hours	0
8	8.5 hours	0
10	17 hours	0
11	10 hours	0
12	15 hours	0
14	23 hours	0
15	36 hours	0
17	8 hours	0
18	16 hours	0
19	12 hours	0
21	6 hours	0
22	22 hours	0
24	24 hours	0
25	12 hours	0
26	23 hours	0
28	38 hours	0.09
29	38 hours	0.06
31	42 hours	0.12
Sept. 2	5 days	0.13
4	3.5 days	0.24
5	56 hours	0.15
7	5.3 days	0.20
8	3 days	0.05
9	3.5 days	0.08
11	8 days	0.08
12	3 days	0.10
14	10 days	0.83
15	10+ days	2.03
16	10+ days	1.76
17	6 days	0.10
18	8 days	0.08
19	3 days	0.07

Methylene Blue Stability

Mile One

Date	Stability	D.O. ppm
July 20	22 hours	0.24
22	20 hours	0
24	18 hours	0
25	9 hours	0
27	11 hours	0
28	14 hours	0
29	16 hours	0
31	4 days	0.12
Aug. 1	64 hours	0.11
3	28 hours	0
4	8 hours	0
5	7 hours	0
7	6 hours	0
8	8 hours	0
10	4 hours	0
11	7 hours	0
12	30 hours	0
14	7 hours	0
15	6 hours	0
17	11 hours	0
18	70 hours	0.19
19	46 hours	0
21	23 hours	0
24	34 hours	0.29
25	14 hours	0.03
26	15 hours	0
28	30 hours	0.04
29	38 hours	0.04
31	62 hours	0.20
Sept. 2	4 days	0.21
4	60 hours	0.10
5	4 days	0.04
7	4 days	0.11
8	3 days	0.09
9	37 hours	0.03
11	33 hours	0.06
12	3.5 days	0.11
14	2.5 days	0.13
15	3.5 days	0.09
16	6 days	0.42
18	7 days	0.79
19	6 days	0.40